SCN-1 800 - 950 MHz SCANNER CONVERTER
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REQUIRED TOOLS

? Soldering Iron (Radio Shack #RS64-2072)
? Thin Rosin Core Solder (RS64-025)
? Needle Nose Pliers (RS64-1844)
? Small Diagonal Cutters (RS64-1845)
? <OR> Complete Soldering Tool Set (RS64-2801)

TOTAL SOLDER POINTS
91

ESTIMATED ASSEMBLY TIME
Beginner............. 4 hrs
Intermediate........ 2 hrs
Advanced............ 1.5 hrs

ADDITIONAL SUGGESTED ITEMS

? Soldering Iron Holder/Cleaner (RS-64-

Manual Price Only: $5.00
Ramsey Publication No. MSCN-1
Assembly and Instruction manual for:
RAMSEY MODEL NO. SCN-1 800 - 950 MHz

RAMSEY

RAMSEY ELECTRONICS, INC.
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Victor, New York 14564
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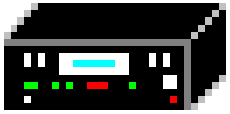
800 - 950 MHz SCANNER CONVERTER KIT



Ramsey Electronics Model No. SCN-1

Tune in on all the action up in the 800 - 950 MHz band with your existing scanner! Utilizes the latest in circuit techniques and easy no tuning design !

? **Converts - without interruption - the 800 - 950 MHz frequencies down to your scanners 400 - 550 MHz (UHF) band !**

? **Get some "hands on" building experience with the latest microwave technology.**

? **Powered by any 9 - 15 VDC source.**

? **Explore and learn about "stripline" circuit routing !**

? **Uses the latest in MMIC technology for reliable low noise and high gain performance !**

? **E - Z hookup with built in "feed thru" antenna connections - no need to disconnect when not in use !**

? **No antenna ??!! Includes helpful instructions for building your own high frequency antenna !**

? **Uses stable crystal oscillator module for drift-free operation !**

? **Complete and informative instructions guide you to a kit that works the first time, every time - enhances resale value, too !**

RAMSEY

PARTIAL LIST OF AVAILABLE KITS:

RAMSEY TRANSMITTER KITS

- FM-10, FM-25 FM Stereo Transmitters
- FM-1,2,4 FM Wireless Microphones
- PB-1 Telephone Transmitter
- AM-1 AM Transmitter

RAMSEY RECEIVER KITS

- FR-1 FM Broadcast Receiver
- AR-1 Aircraft Band Receiver
- SR-1 Shortwave Receiver
- AA-7 Active Antenna
- SC-1 Shortwave Converter

RAMSEY HOBBY KITS

- SG-7 Personal Speed Radar
- SS-70 Speech Scrambler
- TT-1 Telephone Recorder
- SP-1 Speakerphone
- MD-3 Microwave Motion Detector
- PH-10 Peak hold Meter
- LC-1 Inductance-Capacitance Meter

RAMSEY AMATEUR RADIO KITS

- FX Series VHF and UHF Transceivers
- HR Series HF All Mode Receivers
- QRP Series HF CW Transmitters
- CW-7 CW Keyer
- PA Series VHF and UHF Power Amplifiers
- Packet Computer Interfaces
- QRP Power Amplifiers

RAMSEY MINI-KITS

Many other kits are available for hobby, school, scouts and just plain FUN. New kits are always under development. Write or call for our free Ramsey catalog.

SCN-1 800 - 950 MHz SCANNER CONVERTER KIT INSTRUCTION MANUAL
Ramsey Electronics publication No. MSCN-1 Revision 1.4
First printing: August 1994

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The Ramsey Kit Warranty

Please read carefully BEFORE calling or writing in about your kit. Most problems can be solved without contacting the factory.

Notice that this is not a "fine print" warranty. We want you to understand your rights and ours too! All Ramsey kits will work if assembled properly. The very fact that your kit includes this new manual is your assurance that a team of knowledgeable people have field-tested several "copies" of this kit straight from the Ramsey Inventory. If you need help, please read through your manual carefully, all information required to properly build and test your kit is contained within the pages! However, customer satisfaction is our goal, so in the event that you do have a problem, take note of the following.

1. DEFECTIVE PARTS: It's always easy to blame a part for a problem in your kit, Before you conclude that a part may be bad, thoroughly check your work. Today's semiconductors and passive components have reached incredibly high reliability levels, and its sad to say that our human construction skills have not! But on rare occasions a sour component can slip through. All our kit parts carry the Ramsey Electronics Warranty that they are free from defects for a full ninety (90) days from the date of purchase. Defective parts will be replaced promptly at our expense. If you suspect any part to be defective, please mail it to our factory for testing and replacement. Please send only the defective part (s), not the entire kit. The part(s) MUST be returned to us in suitable condition for testing. Please be aware that testing can usually determine if the part was truly defective or damaged by assembly or usage. Don't be afraid of telling us that you 'blew-it', we're all human and in most cases, replacement parts are very reasonably priced.

2. MISSING PARTS: Before assuming a part value is incorrect, check the parts listing carefully to see if it is a critical value such as a specific coil or IC, or whether a RANGE of values is suitable (such as "100 to 500 uF"). Often times, common sense will solve a mysterious missing part problem. If you're missing five 10K ohm resistors and received five extra 1K resistors, you can pretty much be assured that the '1K ohm' resistors are actually the 'missing' 10 K parts ("Hum-m-m, I guess the 'red' band really does look orange!") Ramsey Electronics project kits are packed with pride in the USA. If you believe we packed an incorrect part or omitted a part clearly indicated in your assembly manual as supplied with the basic kit by Ramsey, please write or call us with information on the part you need and proof of kit purchase.

3. FACTORY REPAIR OF ASSEMBLED KITS:
To qualify for Ramsey Electronics factory repair, kits MUST:
1. NOT be assembled with acid core solder or flux.
2. NOT be modified in any manner.
3. BE returned in fully-assembled form, not partially assembled.
4. BE accompanied by the proper repair fee. No repair will be undertaken until we have received the MINIMUM repair fee (1/2 hour labor) of $18.00, or authorization to charge it to your credit card account.
5. INCLUDE a description of the problem and legible return address. DO NOT send a separate letter; include all correspondence with the unit. Please do not include your own hardware such as non-Ramsey cabinets, knobs, cables, external battery packs and the like. Ramsey Electronics, Inc., reserves the right to refuse repair on ANY item in which we find excessive problems or damage due to construction methods. To assist customers in such situations, Ramsey Electronics, Inc., reserves the right to solve their needs on a case-by-case basis.
The repair is $36.00 per hour, regardless of the cost of the kit. Please understand that our technicians are not volunteers and that set-up, testing, diagnosis, repair and repacking and paperwork can take nearly an hour of paid employee time on even a simple kit. Of course, if we find that a part was defective in manufacture, there will be no charge to repair your kit (But please realize that our technicians know the difference between a defective part and parts burned out or damaged through improper use or assembly).

4. REFUNDS: You are given ten (10) days to examine our products. If you are not satisfied, you may return your unassembled kit with all the parts and instructions and proof of purchase to the factory for a full refund. The return package should be packed securely. Insurance is recommended. Please do not cause needless delays, read all information carefully.

TROUBLESHOOTING GUIDE

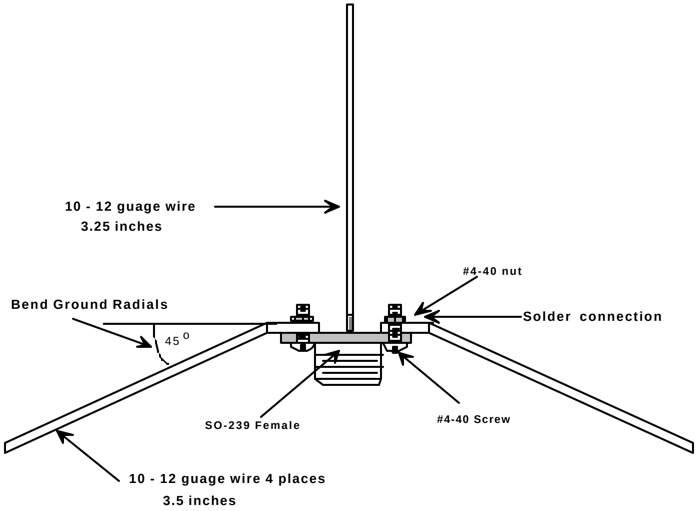
While we had hoped that it wouldn't come to this, if you are having trouble with your scanner converter, here are a few suggestions.

Use a methodical, logical troubleshooting technique. Most problems can be solved using common sense. A volt-ohm meter and a clear head are usually all that are needed to correct any problem. Most problems are due to misplaced parts and/or bad solder connections. Please understand that it is nearly impossible to "troubleshoot" by phone. Thus any specific questions should be documented and sent to us by mail.

ANTENNA CONSIDERATIONS

As the frequency of a signal increases, its wavelength decreases. Since many scanner receivers were not intended to receive the shorter wavelength frequencies, their receiving antennas may not be suited for high frequency reception.

There are several commercially available types of "broadbanded" scanner receiving antennas. Radio Shack ® recently introduced a reasonably priced "discone" type antenna which will work for all the VHF and UHF frequencies, including those of the SCN-1 kit. Also, a portable cellular telephone antenna is well suited to receive the frequencies common to the SCN-1 kit.



Another inexpensive way is to construct your own antenna. Follow the adjacent diagram as a guide to construction.

You can use standard solid copper "house" wiring to construct the elements and ground radials of the antenna.

Ramsey Publication No. SCN-1
Manual Price Only $5.00

KIT ASSEMBLY
AND INSTRUCTION MANUAL FOR

800 - 950 MHz SCANNER CONVERTER SCN-1

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INTRODUCTION

In our modern age of instant access to information and communications, the radio frequency, or RF, spectrum is becoming more and more crowded. Police, fire and a variety of other services have been "pushed up the band" to the 800 - 950 MHz section of the spectrum. These higher frequencies, unfortunately, are out of range for many scanner type radios that were produced a relatively short time ago. In order to receive these higher frequency signals, what is needed is a circuit that can convert these out of range signals to a place where they can be received. That's the purpose of the SCN-1 scanner converter kit.

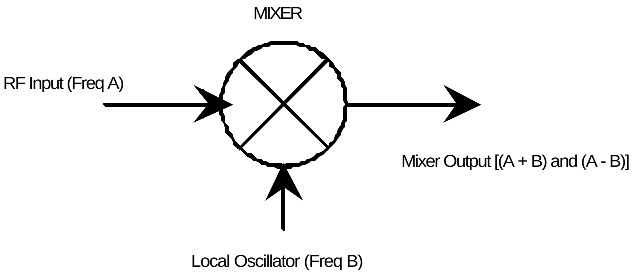
Due to the fact that these signals are approaching 1 GHz (gigahertz, or 1 billion hertz) special attention must be focused on the design and construction of a frequency "down converter." Thankfully, all of the pit falls that such a circuit can hold have been designed out of our kit, making it one of the easiest and most reliable ways to convert your radio to receive microwave frequencies at a reasonable cost.

You'll notice that the PC board included with your kit contains plating on both sides of the board. This topside ground "plane" is necessary to effect the proper impedance of the traces run on the bottom side of the circuit board. Also, we have used the latest in trouble free high gain amplifiers, the Mini Circuits MAR-1 IC, to provide the "mixing" action necessary for obtaining the proper output frequency.

SCN-1 CIRCUIT DESCRIPTION

Before we begin dissecting the circuit, let's have a look at the "big picture" and see what it is that we're trying to accomplish.

Without getting too much into detailed theory, we need to "mix" the incoming signals to the proper frequency range. When two frequencies are mixed together, the resultant outputs are the sum and difference of the two frequencies. Our circuit is designed to mix the 800 - 950 MHz signals down to the 400 - 550 MHz range of your scanner receiver, a difference of 400 MHz.



1. Connect a suitable power source to the SCN-1 PC board via jack J1.
2. Connect your scanner receiver's antenna to jack J3, marked "TO RADIO".
3. Connect an antenna to jack J2, marked "TO ANTENNA". Although your standard antenna may work, you may want to consult the "Antenna Considerations" portion of this manual to devise the correct type of antenna.
4. Energize the unit with the power switch.
5. Tune your scanner receiver to any multiple of 40 MHz i.e. 40, 80, 120, ... MHZ. Your receiver should "quiet" out the background noise and the signal meter should increase. This is due to your sensitive receiver "hearing" the output of the SCN-1's oscillator (or it's harmonics).
6. Tune your receiver to the desired section of the 800 - 950 MHz section of the band. ***Remember to set the radio 400 MHz below your desired frequency.***
7. Adjustment of the two-turn coils L6 and L8 sets the SCN-1's sensitivity. Spread the coils so that there is about a fingernail's width of space between the turns.

That's all there is to it! Your converter is now "mixing" down the out-of-range frequencies to where your scanner receiver can hear them.

8. To check the "feed thru" switch, simply turn the SCN-1 unit off and use your scanner as normal. You should be able to receive all of your previously logged stations.

SCN-1 Test Voltages
using 9V battery supply

✍ 23. Install C20, C19, C18, and C17, all 5 pF disc capacitors. Also carefully top solder all the top side ground plane connections.

✍ 24. Install C14, C15, and C16, all 1 pF (marked 1 or 1K) disc capacitors.

✍ 25. Install L6, the last 2 turn coil.

✍ 26. Install C10, .001 µF disc capacitor (marked .001 or 102). Also solder the top side ground connection.

✍ 27. Identify Q1, a 2SC2498 NPN transistor. When installing Q1, observe correct placement of the flat side. Press the transistor snugly into the PC board so that only a minimum amount of wire lead is exposed above the board. In soldering, do not be afraid of using enough heat to make a good solid connection. This transistor has a non-standard pinout so be sure to follow the parts placement exactly as shown. Top solder the center lead of the transistor to the ground plane.

✍ 28. Install C21, .001 µF disc capacitor (marked .001 or 102).

✍ 29. Install R2, 1K ohm resistor (brown-black-red). Solder the top side ground.

✍ 30. Install C1, .001 µF disc capacitor (marked .001 or 102).

CONGRATULATIONS

You have just completed your SCN-1 scanner converter unit. Take a well deserved break now. Give your eyes a rest. When you return, be sure to check over your work on the entire circuit board. Energizing the circuit board with solder "bridges" or misplaced components can damage your kit.

SCN-1 SET-UP AND TESTING INSTRUCTIONS

IMPORTANT: The SCN-1 is designed to be powered by an external "battery eliminator" supply, using the "power" jack J1. A 9 - 12 volt regulated DC supply is recommended, with the "center" pin of the connector being the positive (+) connection.

Now it's time to "check out" the SCN-1. Use the following steps to help you through this relatively easy procedure.

At the heart of the converter circuit is the 40 MHz oscillator module, or OSC 1 as shown on the schematic. The output of the module is amplified by transistor Q1. This amplifier is purposefully designed to generate "harmonics" or frequency multiples of the original fundamental frequency. This amplifier's stable output is then bandpass filtered 4 times so that only the 10th harmonic (at 400 MHz) is present at the input of the MAR-1 amplifier.

The incoming RF signal is high pass filtered using components C4 - C7 in combination with inductors L2 - L4. Don't look for these coils in your parts kit, however, because they have been "etched" into the circuit board! This technique for using the circuit board traces as actual components is referred to as stripline design, and is quite common for microwave circuits.

The MAR-1 then amplifies the inputs non-linearly, producing the needed mixing action. The output is then routed to the output jack, J3.

Calculating the proper receive frequency is a simple operation. For example, if you wish to receive the 903 MHz HAM radio band, the difference of the frequencies (903 MHz - 400 MHz = 503 MHz). So the easiest way of "thinking" what the scanners frequency will be is to take the scanner receiver's dial frequency and add 400 MHz to it.

The signal is "bypassed" through the power switch when the power is turned off. By selecting the proper PC trace width, the feedline impedance is not affected and no "loss" is encountered when bypassing the mixing circuit.

RAMSEY Learn-As-You-Build KIT ASSEMBLY

There are numerous solder connections on the SCN-1 printed circuit board. Therefore, PLEASE take us seriously when we say that good soldering is essential to the proper operation of your transmitter!

? Use a 25-watt soldering pencil with a clean, sharp tip.

? Use only rosin-core solder intended for electronics use.

? Use bright lighting, a magnifying lamp or bench-style magnifier may be helpful.

? Do your work in stages, taking breaks to check your work. Carefully brush away wire cuttings so they don't lodge between solder connections.

We have a two-fold "strategy" for the order of the following kit assembly steps. First, we install parts in physical relationship to each other, so there's minimal chance of inserting wires into wrong holes. Second, whenever possible, we install in an order that fits our "Learn-As-You Build" Kit building philosophy. This entails describing the circuit that you are building, instead of just blindly installing components. We hope that this will not only make assembly of our kits easier, but help you to understand the circuit you're constructing.

For each part, our word "Install" always means these steps:

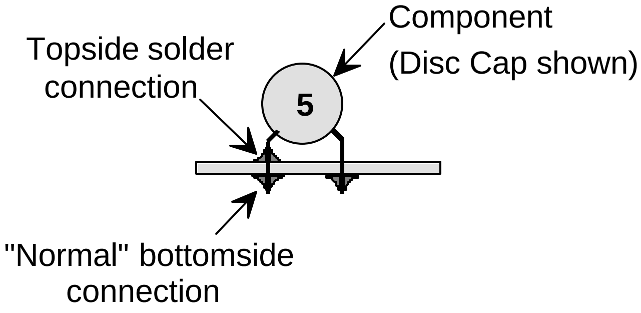
1. Pick the correct part value to start with.

2. Insert it into the correct PC board location.

3. Orient it correctly, follow the PC board drawing and the written directions for all parts - especially when there's a right way and a wrong way to solder it in. (Diode bands, electrolytic capacitor polarity, transistor shapes, dotted or notched ends of IC's, and so forth.)

4. Solder all connections unless directed otherwise. Use enough heat and solder flow for clean, shiny, completed connections.

DOUBLE SIDED COMPONENT SOLDERING INSTRUCTIONS:



You'll notice that the circuit board contains plating on both sides of the board, with a large ground "plane" area on the component side of the circuit board. In order to electrically connect this topside ground plane to the bottomside ground connections, it will be necessary to solder some components on both the top and bottom side of the circuit board.

These topside connections will be clearly pointed out when necessary in the assembly instructions. When so instructed, be sure the solder "flows" the topside connection, as shown. If topside soldering a disc capacitor, be sure to scrape away any insulating material which may be coated on the lead near the components' body.

Another important consideration when building high frequency RF circuits: **Keep the component lead lengths as short as mechanically possible to keep the components close to the circuit board!** This will avoid adding

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polarized with a (+) and a (-) lead and must be installed in the correct orientation. Ordinarily, only the negative side is marked on the capacitor body with a dark band and the (-) sign clearly shown, while the PC board or Parts Layout Diagram will usually show the (+) hole location. Use care to ensure proper polarity, as these components can explode if installed incorrectly!

✍ 11. Install C12, the other 10 µF electrolytic. Watch that polarity!

✍ 12. Install L5, 10 µH (marked LQ105 or 10 µH; green body w/brown-black-black bands). This completes the DC path to the +9V DC bus of your converter while "choking" the RF energy off of the DC line. That's how we use the power switch for "double duty", to control the DC voltage and also bypass the RF signal.

Recheck your work for errors and correct any that you find. Next we'll get to work on the filters and amplifier components contained in our circuit.

✍ 13. Install C4, 5 pF disc capacitor (marked 5 or 5K).

✍ 14. Install C5, 2 pF disc capacitor (marked 2 or 2K).

✍ 15. Install C6, another 2 pF disc capacitor.

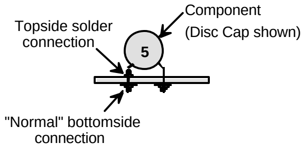
✍ 16. Install C7, another 5 pF disc capacitor.

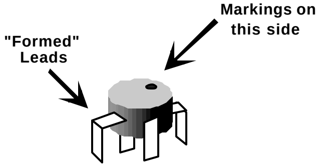
✍ 17. Install resistor R1, 220 ohm (red-red-brown).

✍ 18. Install C8, .001 µF disc capacitor (marked .001 or 102).

✍ 19. Install C2, another .001 µF disc capacitor (marked .001 or 102). Solder the top side ground connection to this component.

✍ 20. Identify the MAR-1 MMIC amplifier. Notice that one lead of the component is marked with a white arrow or a brown dot. This marking denotes the input pin of the amplifier. Be sure that the marking is visible on the top side of the component and is facing as shown in the Parts Layout Diagram. Pre-form the component leads to exit the body at a right angle straight down as not to strain them when installing this component. Push the part flat to the circuit board, and solder all four connections. Top solder the ground plane connections of the amplifier.





✍ 21. Install inductors L9, L7, and L8. They are all 2 turn, wire wound inductors. These components should stand upright with the leads pushed through the board far enough so that the bottom of the coil touches the circuit board. Solder the top side ground connections of these components.

✍ 22. Install C9, 2 pF disc capacitor (marked 2 or 2K).

stray capacitance or inductance into the circuit.

ASSEMBLY INSTRUCTIONS

✍ 1. Install jack J2, the antenna input RCA PC mount type. These connectors will “snap” into place before soldering. Don’t be afraid to completely solder all three ground connections as these will also limit the “stress” on the input and antenna connections. Solder all four “tabs”on the bottom, and solder the topside of the three grounding “tabs”. Be sure to use enough heat to properly “flow” the connection.

✍ 2. In the same manner, install jack J3. Remember to top solder the three grounding tabs on this component.

✍ 3. Install jack J1, the DC power connection. Solder both points and also top solder the exposed ground connector.

✍ 4. Install pushbutton switch S1. Orient the switch so that the plunger extends over the edge of the PC board. Be sure to push the switch flush to the circuit board. Solder all six pins.

That wasn’t so bad, now was it! Recheck your connections for a shiny, smooth solder fillet connecting the component to the PC trace. Touch up any poor looking connections. We’ll continue now by building the power supply and the 40 MHz oscillator circuit.

✍ 5. Install L1, 10 µH inductor (marked LQ105 or 10 µH; green body w/ brown-black-black bands).

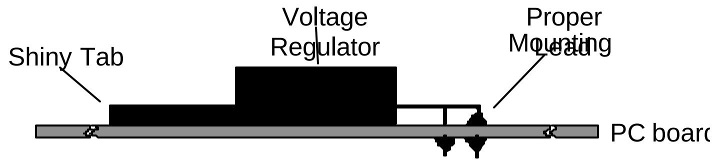
✍ 6. Install C3, .001 µF disc capacitor (marked .001 or 102).

✍ 7. Install C11, another .001 µF disc capacitor. This cap acts as a “bypass” - it effectively is a short circuit to ground to any high frequency AC waveform that is “riding” on top of the 5 volt DC level. This keeps any AC noise from creeping into your circuit, without changing the DC level.

✍ 8. Identify the oscillator module OSC1. Notice that one pin is marked with a dot on the top side of the component, or in some versions, only one side has a square pointed corner. It must be aligned and mounted as shown in the Parts Layout Diagram. Solder it to the PC board using your best soldering etiquette!

✍ 9. Locate the 7805 voltage regulator, VR1. Notice the three leads extending from the component. Mount the component “laying down”, as shown. Top solder the center “ground” pin of the regulator, as shown.

✍ 10. Install C13, 10 µF electrolytic capacitor. Electrolytic capacitors are



SCN-1 PARTS LIST

Sort and “check off” the components in the boxes provided. It’s also helpful to sort the parts into separate containers (an egg carton does nicely) to avoid confusion while assembling the kit.

RESISTORS

✍ 1 220 ohm resistor [red-red-brown] (R1)
✍ 1 1K ohm resistor [brown-black-red] (R2)

CAPACITORS

✍ 3 1 pF disc capacitors [marked 1 or 1K] (C14, 15, 16)
✍ 3 2 pF disc capacitors [marked 2 or 2K] (C5, 6, 9)
✍ 6 5 pF disc capacitors [marked 5 or 5K] (C4, 7, 17, 18, 19, 20)
✍ 7 .001 uF disc capacitors [marked .001 or 102] (C1, 2, 3, 8, 10, 11, 21)
✍ 2 10 uF electrolytic capacitors (C12, 13)

INDUCTORS

✍ 4 2 turn wire inductors (L6, 7, 8, 9)
✍ 2 10 uH inductors [marked LQ105 or 10uH; green body w/brown-black- black bands] (L1, 5)

SEMICONDUCTORS

✍ 1 2SC2498 or 2570 NPN transistors [marked 2498](Q1)
✍ 1 MAR - 1 MMIC amplifier [small black “button” with 4 leads] (U1)
✍ 1 5 volt voltage regulator [marked 7805] (VR1)

MISCELLANEOUS PARTS AND HARDWARE

✍ 1 40 MHz oscillator module [marked 40.000] (OSC1)
✍ 1 PC mount DC power jack (J1)
✍ 2 RCA type PC mount jack (J2, 3)
✍ 1 Pushbutton switch
✍ 1 SCN-1 printed circuit board

Now, let's get building!

Since you may appreciate some “warm-up” soldering practice as well as a chance to put some “landmarks” on the PC board, we’ll first install some “hardware” components. This will also help us to get acquainted with the up - down, left - right orientation of the circuit board.

SCN-1 PARTS LAYOUT DIAGRAM